surface area for filtration of the substrate. (see col 6, lines 42-44).

basis for "surface area at least greater than 1 m^2" is:

"the skein preferably has a surface area which is at least >1 m^2" (see col 3, lines 16 - 17);

basis for "cylindrical headers" is in the drawings showing cylindrical headers, and the description of how they are formed in the specification, stating:

integral header is preferably directly potted in a ring of suitable material from which the header of cured potting resin is not removed, (see col 8, lines 7-10).

basis for "fibers having a length between opposed surfaces of the headers, in the range from 0.1% to 5% greater than the distance between opposed surfaces of the headers;" is:

The length of fibers between opposed surfaces of headers from which they extend, is in a critical range from at least 0.1% (percent) longer than the distance separating those opposed faces, but less than 5% longer. (see col 3, lines 22-25).

basis for ". . . having through-passages with openings, distributed both radially and circumferentially within the skein for discharging air directly into the substrate near the base of the skein, the openings providing a column of bubbles rising . . . " is illustrated in the drawings and described in the specification as follows:

Figs. 3, 3A, 6 and 7, and,

The star-shaped sparger 40 having radially outwardly extending tubular arms 41 and a central supply stub 42, supplies air which is directed into the tubular arms and discharged into the substrate through air passages 43 . . . (see col 12, lines 3-7);

and,

> After potting, a star-shaped sparger or other shaped gas-distribution means is positioned near the base of the skein fibers. (specification, col 6, lines 18-20);

and,

> . . . the novel configuration efficiently uses air discharged near the base of a skein to produce bubbles in a specified size range, and in an amount large enough to scrub the fibers, and to provide controlled scrubbing of fibers one against another ("inter-fiber scrubbing"). (specification, col 1, lines 29-34);

and,

> (ii) a gas-scrubbing means which produces a column of bubbles rising within and near the base of the skein, and engulfing the skein. (specification, col 8, lines 45-48);

and, also see claim 1 col 24, lines 20-23.

basis in claim 16, for "wherein the length is in the range from 0.1% to 1% greater"

> Usually the length of fibers is less than 2% longer, and most typically, less than 1% longer, so that sway of the fibers is confined within a vertical zone of movement, the periphery of which zone is defined by side-to-side movement of outer skein fibers; (see col 3, lines 26-30).

basis in claim 17, for "a rigid air supply tube for discharging air through the through-passages and for spacing and positioning the lower and upper headers relative to one another" is illustrated in the drawing and described in the specification as follows:

> a rigid air supply tube is inserted through the upper end-cap and upper header into the central portion of the skein, the lower portion of the air supply tube being potted in the lower header, thus functioning as a spacer means, (see col 5, lines 9 - 13);

basis in claim 18, for ". . . the air supply tube has additional through-passages along its length" is described in the specification as follows:

> Additional ports may be provided along the length of the vertical air supply tube, if desired. (specification, col 16, lines 34-36).

The appended freshly executed Declaration of the inventors which identifies at least one error which is relied upon to support the reissue application, and which states that the error arose inadvertently without deceptive intent, is believed to obviate the objection regarding the prior Declaration.

The rejection of claim 15 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,248,424 to Cote et al, or to "Cote et al and Applicants' disclosure", is respectfully traversed.

It is conceded that Cote et al '424 patent discloses a system including a reservoir and a skein of fiber membranes immersed in the reservoir of substrate; that the membranes are sealed within the headers; that the permeate is collected through a permeate collection means using a suction pump; and an aeration means is used to provide bubbles to scrub the skein.

Regarding the length of the fibers, the possible misconstruction as to the definition of length of the fibers as suggested in the office action, is avoided by the amended claim 15. Applicants submit that the '424 patent does not disclose fibers having a length between opposed surfaces of the headers in the range of 0.1% to 5% greater than the distance between opposed surfaces of headers.

Regarding the cylindrical skein, the office action cites col. 18, lines 34-38 and Fig. 3A of the '424 patent referring to skeins of vertically spaced apart headers that

are "conventional in the art" and the device discussed at col 9, lines 65 to col 10, line 2 in the same patent. Applicants wish to consider each of these in turn, dealing first with the cited portions of the '424 patent.

Considering col 18, lines 34-38 of '424, it states:

> It will now be evident that a header with a circular periphery may be constructed, if desired. Headers with geometries having still other peripheries (for example, an ellipse) may be constructed in an analogous manner, if desired, but rectangular headers are most preferred.

Applicants submit that this paragraph discloses that a circular header may be used instead of a rectangular or elliptical one, or one with any other geometry. The cylindrical skein claimed in claim 15 requires fibers of defined length disposed generally vertically between upper and lower headers.

Considering Fig 3A, the office action states that "Reference '424 **fails to disclose** placing the skein of hollow fibers in the reservoir in **vertical position**, ..." as claimed, Applicants nevertheless wish to point out that Fig 3A is discussed in the specification as follows:

> FIG. 3A is *a detail, not to scale,* illustratively showing a gas distribution means discharging gas between rows of fibers in a header. (see col 14, lines 13-15).

In greater detail, the specification describes what Fig 3A illustrates:

> Referring to FIG. 3A there is shown *a side elevational view of a header 41 fitted with a permeate collection pan 43 from which a permeate withdrawal conduit 45 withdraws permeate.* Four rows of fibers 12 with their potted terminal end portions 12' opening into the pan 43, are shown on either side of a gas distribution line 52 which traverses the length of the rows along the base of the fibers. In an analogous manner, a gas distribution line is provided near the base of the opposed terminal end portions of the fibers in the other header of the array. Gas issuing from the line 52, *and from the corresponding gas line in the opposed base of the fibers of the skein, effectively aerates the entire skein.* (see col 20, lines 15-28).

To begin, as stated in the specification, the detail illustrated in Fig 3A, is not to scale but illustrative. The detailed description of the various numerically identified elements in Fig 3A, not surprisingly, refers to Fig 3 which shows the arched configuration. Further, the reference to gas issuing from the corresponding gas line in an opposed base of the fibers of the skein indicates that the header in Fig 3A is not part of a pair of upper and lower headers. Thus Fig 3A does not disclose fibers of the claimed length disposed generally vertically between upper and lower headers.

Considering col 9, lines 33-64, this discussion pertains to the Chiemchaisiri et al reference discussed immediately above the cited portion. Applicants acknowledge that this reference discloses downwardly arranged fibers but submit that mere disclosure of downwardly suspended fibers does not suggest the claimed cylindrical skein of fibers. The description of the membrane module itself is minimal and unclear. What is clear is that the module has no lower header (see Fig 1) and that the modules are confined within a "separation unit" (see section entitled "Experimental System"). The disclosure of downwardly suspended fibers with no lower header cannot suggest fibers of the claimed length between upper and lower headers. Further, as disclosed at col 9 lines 33-64 of the '424 patent, Chiemchaisiri et al used a combination of paddle wheels and jet aeration from the side, to maintain clean fibers. Thus Chiemchaisiri's apparatus did not use the aeration means in combination with a skein of fibers as claimed by the Applicants.

In summary, Applicants submit that the '424 patent does not make obvious a cylindrical skein of hollow fiber membranes disposed generally vertically between upper and lower headers, the fibers having a length between opposed surfaces of the headers, in the range from 0.1% to 5% greater than the distance between opposed surfaces of the headers with aeration means having through-passages with openings, distributed both radially and circumferentially within the skein for discharging air directly into the substrate near the base of the skein.

Considering the reference in the office action to skeins "conventional in the art", taken in the broad sense, Applicants submit that such art in relation to a vertical skein at the time of Applicants' invention, involved placing each skein in a shell and

then inserting the enclosed skeins in a pressure vessel (e.g. as described in U.S. Patents Nos. 4,756,875; 4,775,471; 4,876,006 and 5,151,191). Applicants' vertical skein is not contained in a pressurized vessel and is not confined in a shell. Operation in a reservoir at ambient pressure without a shell differs from such prior art systems in a number of ways. For example, a shell may provide structure to a skein of fibers and force bubbles to remain near the skein to generate a strong air lift or "chimney effect" for circulating substrate through the shell. Further, pressurized systems provide a well-controlled flow of substrate that assists in maintaining clean fibers. In the absence of a pressurized vessel and a skein confined in a shell, it is much more difficult for bubbles to scour fibers and remove pore-clogging matter around the fibers.

Applicants submit that it would not have been obvious to one of ordinary skill in the art, at the relevant time, to remove a cylindrical skein from its shell and its pressurized vessel and place it in a tank at ambient pressure. None of the conventional vertical skeins suggested all the features recited in parts (b), (c) and (d) of claim 15 as a combination which could be removed from its shell and pressurized vessel. Further, the prevalent use of a shell and a pressurized tank suggests that it was not obvious to do without them. While the inventors and others have since demonstrated that it is possible to place an appropriate device into an unpressurized tank, it is not permissible to rely on hindsight to deny Applicants' claim.

Applicants are aware of only one reference, Japanese publication No. 7-136470 that describes a vertical skein of fibers in an unpressurized vessel prior to the filing date applicants are entitled to. A copy of the publication, titled "Air Dispersion Tube Equipped Hollow Fiber Membrane Module and Assembly" with a side-by-side machine translation, is enclosed herewith. A translation by a human translator will be forwarded as soon as it is available. Applicants first saw a copy of this Japanese '470 reference in February 2001 when it was cited in an Australian patent application corresponding to their U.S. application.

All embodiments of the '470 invention show a hollow fiber membrane module in which the fibers are held together in the form of a knitted or woven fabric (see, particularly, claims 2, 3, 4 and 5). Figure 2 of the '470 reference also fails to show

headers locked is spaced-apart relationship by the air tube. The specification states that the fibers may be made from cellulose, polyolefins, polyvinyl alcohol or other synthetic resinous materials used to form hollow fiber membranes, and that the modules are for use in highly fouling water (see P. 2 of the machine translation in which the page numbering is provided in the right hand lower corner of each page).

Both Figs 1 and 2 of the '470 reference show a hollow fiber membrane module in which the shape of the skein is ellipsoidal (elliptical in two dimensions). Fig 1 shows a skein in a horizontal position with an air dispersion tube locked to the skein directly beneath it. Fig 2 shows a vertical skein of fibers locked to a ring-shaped aerator near the base of the skein.

Figs 3 and 4: each shows an array of taut fibers held together in the form of a sheet stated to be formed by weaving the linear fibers together with yarns which keep them spaced-apart. Opposed ends of the fibers are potted in headers and permeate may be withdrawn from one or the other header, or both.

Fig 5 shows several modules, each in sheet form and laterally spaced apart by their individual headers, all of which headers are ganged together with common upper and lower permeate withdrawal manifolds and aeration tubes located transversely across the bottoms of the sheets.

In Figs 3, 4 and 5 it is evident that the fibers cannot move relative to one another and one fiber cannot rub against an adjacent fiber as they are in sheet form, woven in spaced-apart configuration. There is no indication that the fibers in the modules shown in Figs 1 and 2 are individual fibers potted only at their ends, so as to be free to move relative to one another.

Considering Figs 1 and 2 in greater detail, note that illustrating the fibers in ellipsoidal form is not incidental or accidental. The ends of the fibers are stated to be "converging" (see P. 3 of the machine translation; and second last line of P. 6). Since the fibers are stated to be in sheet form, there is no reason to believe that they are swayable.

Referring first to Fig 1, there is no indication whether the module is diagrammatically illustrated as being in operation, immersed in a liquid; or whether

the module is shown resting on a table in the ambient atmosphere. Assuming it is shown in operation, air bubbles would force the fibers into a convex configuration, with an upward arch. If the module was immersed in water and resting on the floor of a tank with no aeration under the fibers, they would seek a convex configuration, with an upward arch because fibers of synthetic resinous materials (identified above) have a specific gravity less than that of water, especially highly fouled water. If the module was resting on a table, the fibers would hang downward, each attempting to arrive at its own catenary, taking into account the constraint of the yarn weaving the fibers together. In neither instance would the fibers present an ellipsoidal configuration.

It is believed that Figs 1 and 2 show some means of holding the fibers in a desired shape such as a hollow ellipsoidal cage of wire woven into a sheet through adjacent interstices of which fibers are laterally threaded so that they form a single layer of fibers shaped as an ellipsoid. During operation, whether in the horizontal or vertical position the ellipsoid retains its shape. Such a configuration is far removed from the skein defined in the system claimed in claim 15.

Fig 2 also shows aeration means unlike Applicants' claimed aeration means. In particular, the through-passages in the '470 reference are outside the skein, whereas in Applicants' claim the through-passages are located within the skein. Further, the through-passages in Applicants' claimed system are distributed radially whereas those in the '470 reference are not. In Example 3 (col 19, line 34 to col 20 line 21) of Applicants' disclosure, a test is described comparing external and internal aeration. For external aeration, a skein is aerated by a perforated flexible tube wrapped around the base of a skein. For internal aeration, through-passages are provided along five spokes radiating from a central gas tube thus providing through-passages distributed radially and circumferentially within the skein. As shown in Fig 14, the internal aeration provided a substantial improvement in flux.

In summary, it is respectfully submitted that the claims as amended are patentable over the cited references and the '470 reference.

The reissue declaration filed herewith overcomes the objections raised in the

office action.

The Information Disclosure Statement filed herewith identifies some of the many references which were presented in an Opposition proceeding against the corresponding Australian patent application and received February 9, 2001; those references deemed irrelevant are not presented.

In view of the foregoing remarks, arguments, and amendments to the specification and the claims, it is respectfully submitted that the basis for the rejection of claim 15 has been overcome and that the claim is now in condition for allowance. Claim 16 - 18 depend from claim 15 and more narrowly define the invention.

Respectfully submitted,

Alfred D. Lobo (Reg. No. 24,109)

CERTIFICATE UNDER 35 U.S.C. 1.8(a)

I certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on this 29th day of March 2001.

Alfred D. Lobo
Attorney for Applicant(s)
Registration No. 24,109

Date: 29 March 2001

LOBO & CO.,L.P.A.
933 The Leader Building
526 Superior Avenue
Cleveland, OH. 44114-1401.
Voice (216)-566-1661
Fax (216)-241-4037

9501are\621234.am1

MARKED-UP VERSION

Only claim 15 was added in the reissue application filed, and it has been amended as shown below, though, for the sake of clarity, the underlining of the original claim is not maintained; instead, underlining in the following claim shows only what is added; what has been deleted is bracketed.

The dependent claims are not reproduced below because they have been added as shown on the second page of the Amendment.

15. (Amended) A system for treating a multicomponent liquid substrate while leaving particulate matter therein, comprising,

(a) a non-pressurized reservoir other than a shell of a module for containing the substrate;

(b) a cylindrical skein of hollow fiber filtering membranes immersed in [said] the substrate each fiber having a length greater than 0.5 m, the fibers together providing a surface area at least greater than 1 m^2 and [having said membranes] disposed generally vertically between upper and lower cylindrical headers such that (i) outsides of ends of said membranes are sealingly secured to the headers in a closely spaced apart relationship, (ii) lumens of said fibers being in fluid communication with at least one permeate collection means, and, (iii) said fibers having a length between opposed surfaces of the headers, in the range from 0.1% to 5% greater than the distance between opposed surfaces of the headers;

(c) a pump in fluid communication with said lumens of said membranes through at least one permeate collection means, said pump operable to apply a suction to the lumens of the membranes to draw a component of the substrate as permeate through said membranes while leaving particulate matter in said substrate; and,

(d) aeration means having through-passages with openings, distributed both radially and circumferentially within the skein for discharging air directly into the substrate near the bottom of the skein, the openings providing a column of [rising] bubbles rising from near said outsides of said membranes' lower ends.